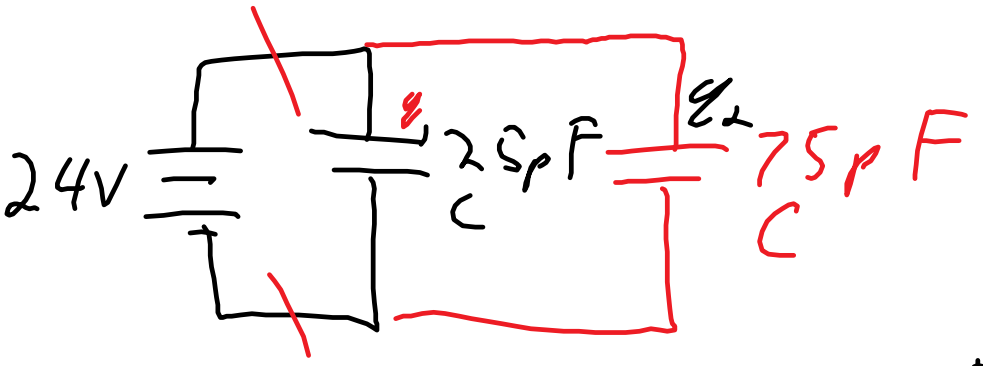
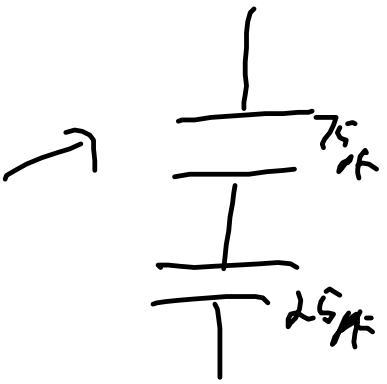
# P472 Q28 Cambridge study guide




$C = \frac{q}{V}$ $q = CV = 25pF \times 24V$

$= 600\ pC$

$V = \frac{q}{C}$ $V_1 = V_2$

$\frac{q_1}{C_1} = \frac{q_2}{C_2}$ $q_1 + q_2 = q_0$

$Energy = \frac{1}{2} C_1 V^2 + \frac{1}{2} C_2 V^2$

$= \frac{1}{2} C_1 V_0^2$

$\frac{1}{2} 25pF \times (24V)^2 = 7200\ pJ$

7.2 nJ

$$\frac{(q_0 - q_2)}{C_1} = \frac{q_2}{C_2}$$

$$\frac{600\text{pC} - q_2}{25\text{pF}} = \frac{q_2}{75\text{pF}}$$

$$600\text{pC} - q_2 = \frac{1}{3} q_2$$

$$q_2 = 600\text{pC}\left(\frac{3}{4}\right)$$

$$q_2 = \underline{450\text{ pC}}$$

$$q_1 = \underline{150\text{ pC}}$$

$$\text{Energy} = \frac{1}{2}(25\text{pF})\left(\frac{150\text{pC}}{25\text{pF}}\right)^2 + \frac{1}{2}(75\text{pF})\left(\frac{450}{75}\right)^2$$

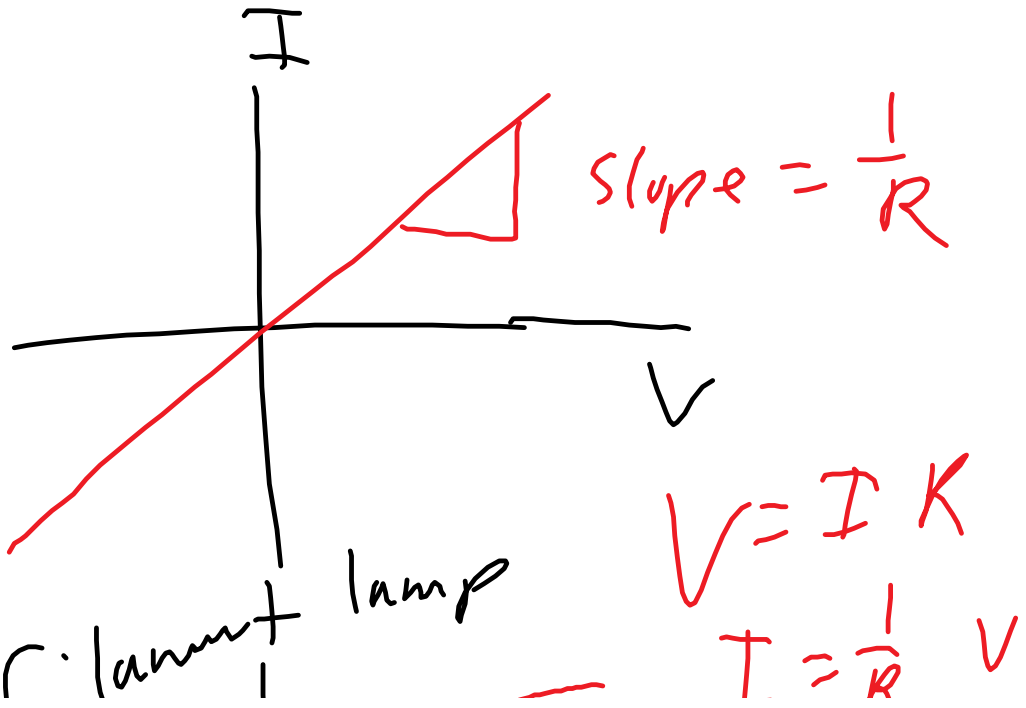
$= 450\,pJ + 1350\,pJ$

$= 1800\,pJ$

$7200\,pJ$
$-1800\,pJ$
$5400\,pJ$ ✓

Draw the I vs V graph for
a) An ohmic device (resistor)
b) A filament light bulb
c) diode

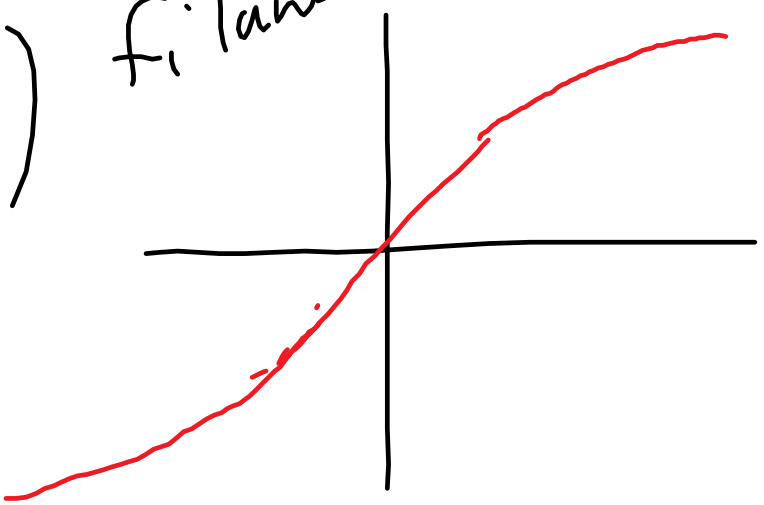
a)



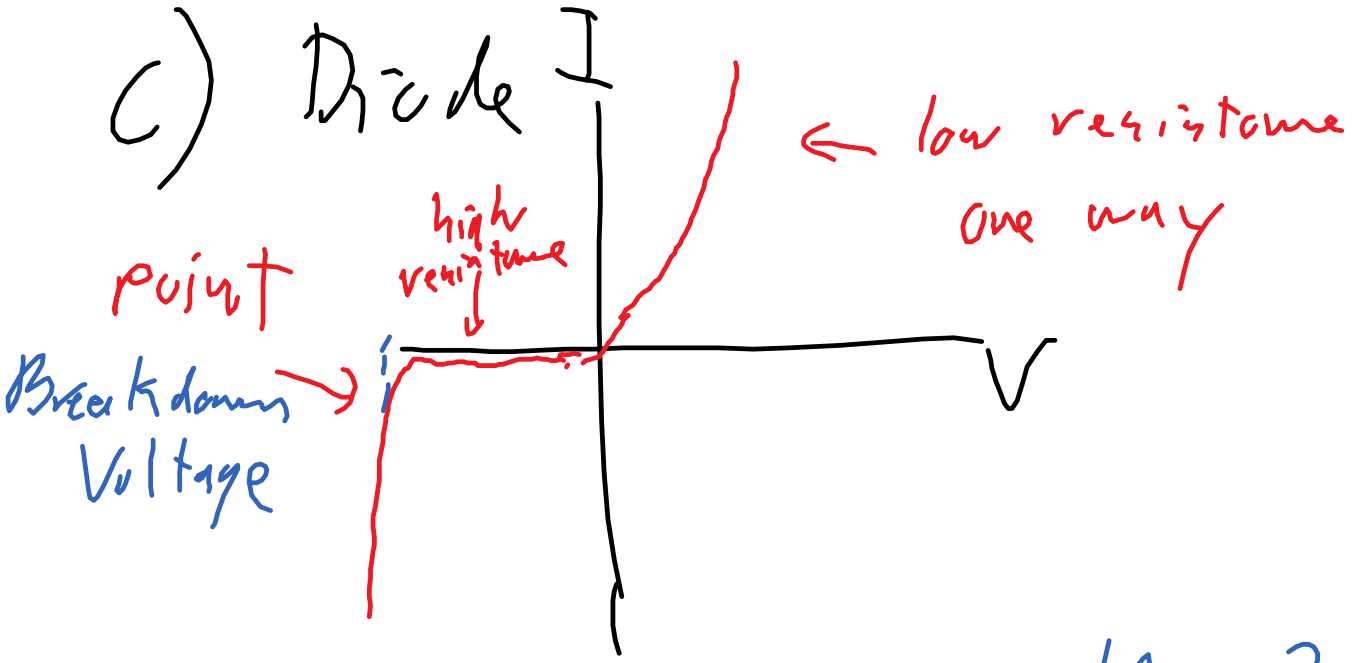

c. lamp filament

b) filament

$I = \frac{1}{R} V$



c) Diode




Why do diodes do this? ← doping

How can we use this?

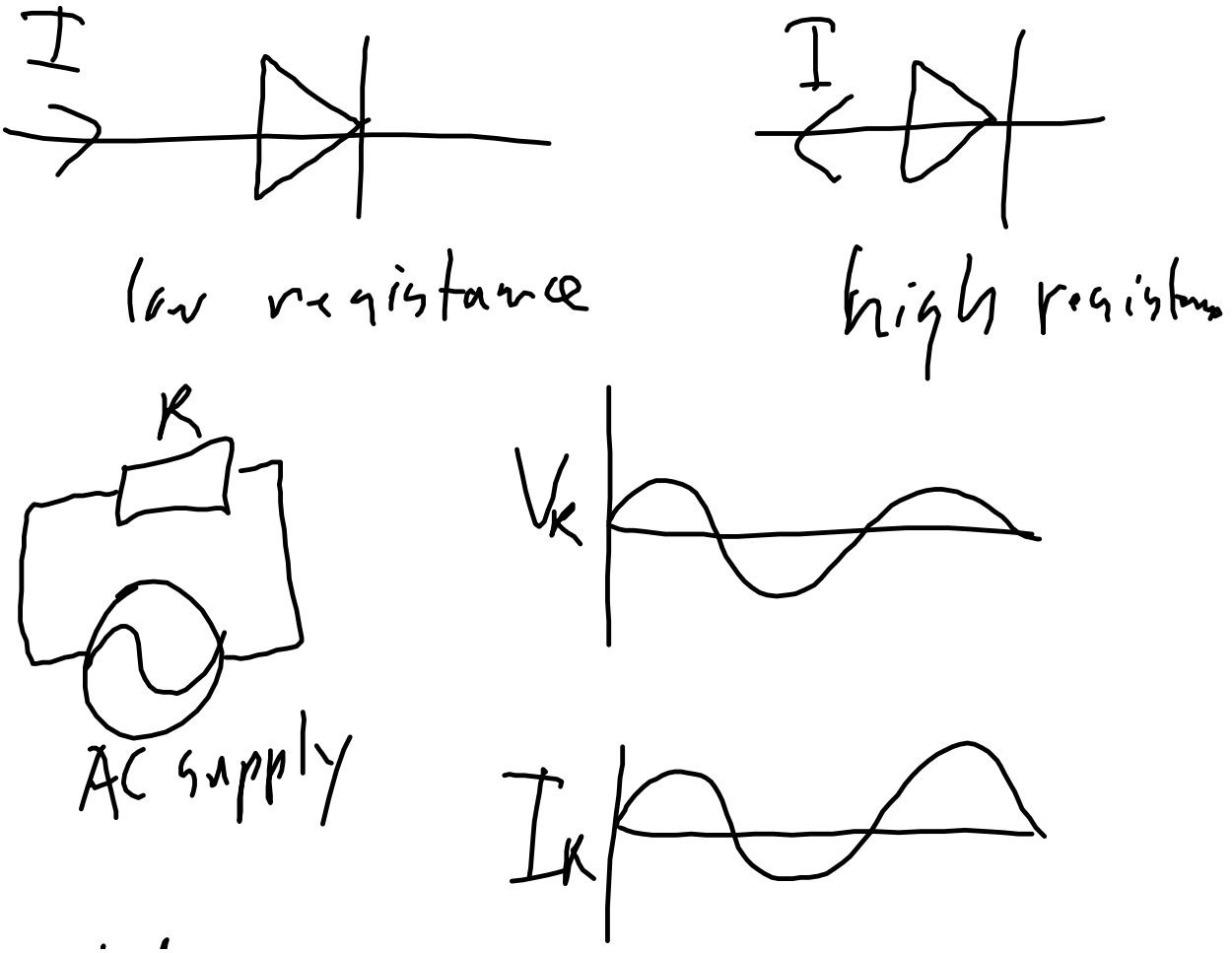
AC → DC Converter rectification

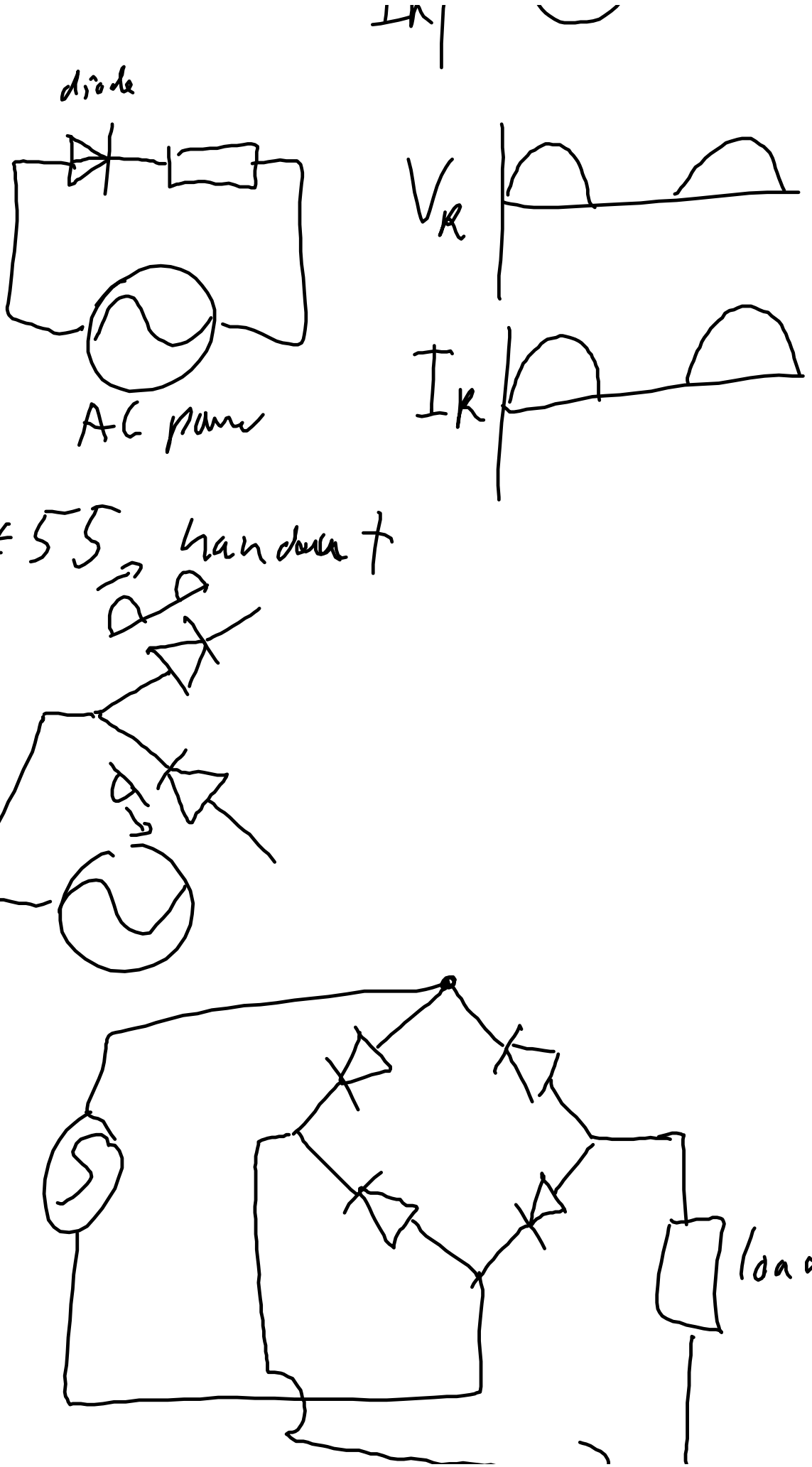
You build a diode using a semiconductor with different compounds embedded - this process of embedding materials is called doping.

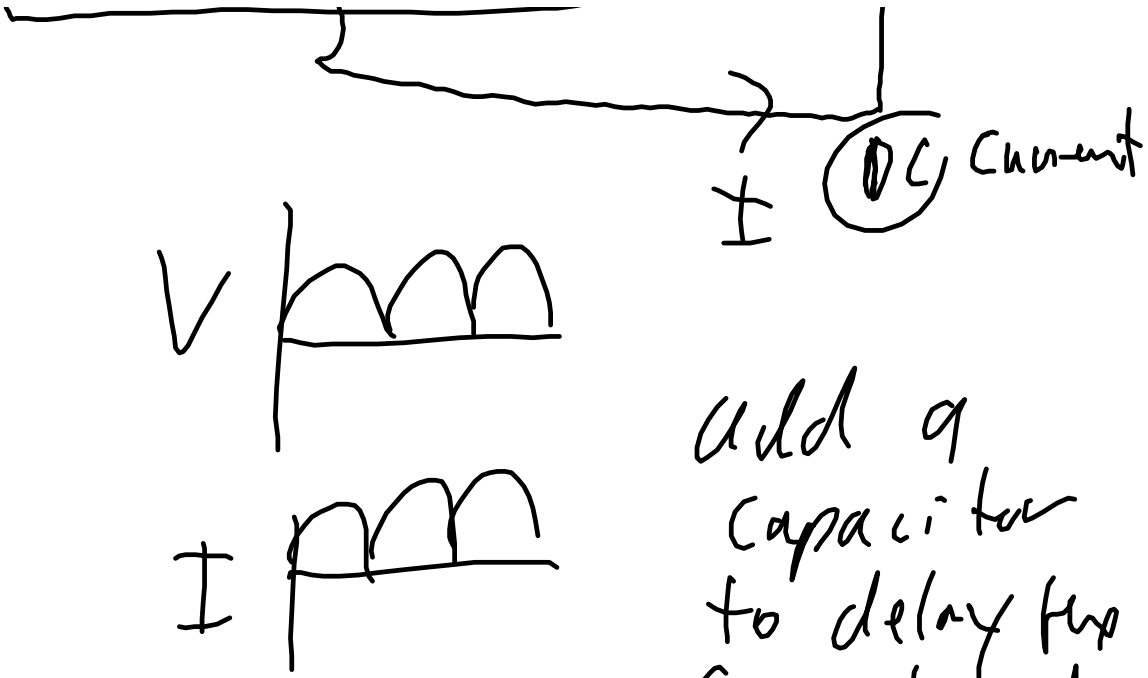
If you embed a material that lacks an electron in the outer orbit, it is called a "hole" because electrons will tend to go into the hole.

If you embed a material with extra electron in the outer orbit, it will tend to give off electrons.

Boundary between the two different materials, creates a potential boundary - prevents current from going towards the extra electrons.




diode
AC pow
$V_R$
$I_R$
P455 handout
load

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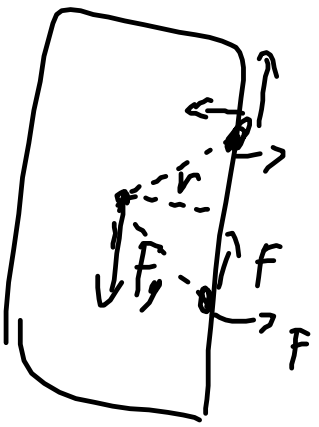
https://www.youtube.com/watch?v=cyhzpFqXwdA
Video on rectifiers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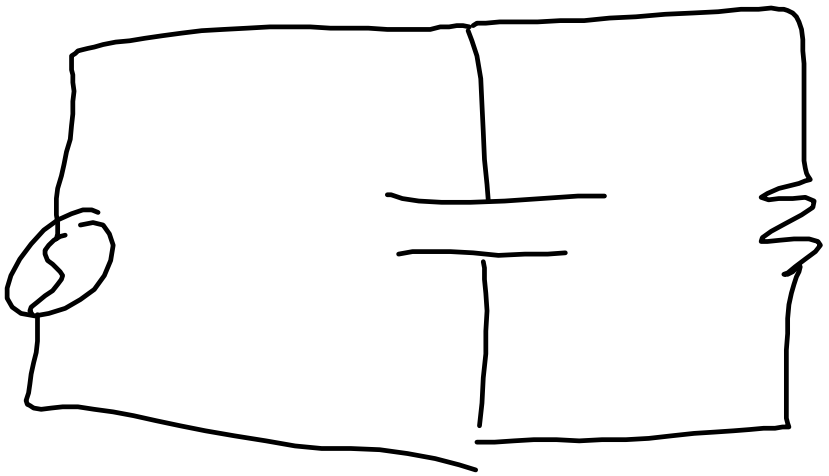

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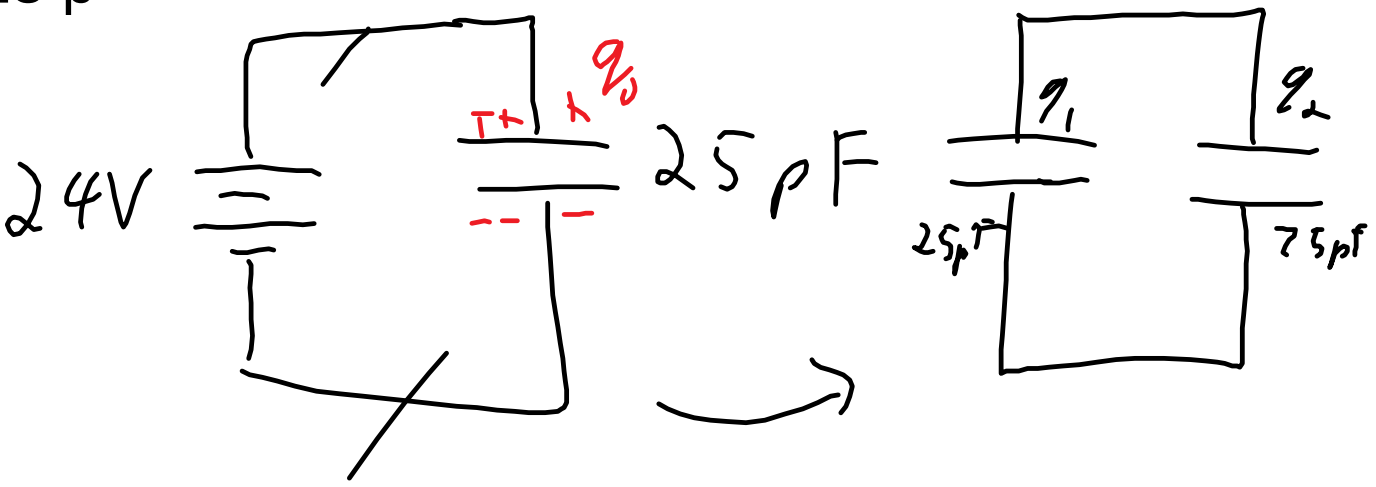



$$C = \frac{q}{V} \qquad q_0 = CV = 24V \times 25pF = 600pC$$

$$V_1 = V_2 \qquad q_1 + q_2 = q_0$$

$$\frac{q_1}{C} \qquad \frac{(q_0 - q_1)}{C}$$

$$\frac{q_1}{C_1} = \frac{q_2}{C_2} \qquad C_1 \qquad C_2$$

$$\frac{(600\,pC - q_2)}{25pF} = \frac{q_2}{75pF}$$

$$600\,pC = \frac{4q_2}{3}$$

$$q_2 = 450\,pC \qquad q_1 = 150\,pC$$

6) $$\text{Energy} = \frac{1}{2}CV^2 = \frac{1}{2}25pF(24V)^2$$

$$= 7200\,pJ$$

$$\text{Energy final} = \frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2$$

$$\frac{1}{2}25pF\left(\frac{150pC}{25pF}\right)^2 + \frac{1}{2}(75pF)\left(\frac{450pC}{75pF}\right)^2$$

$$450\,pJ + 1350\,pJ$$

$= 1800\,pJ$

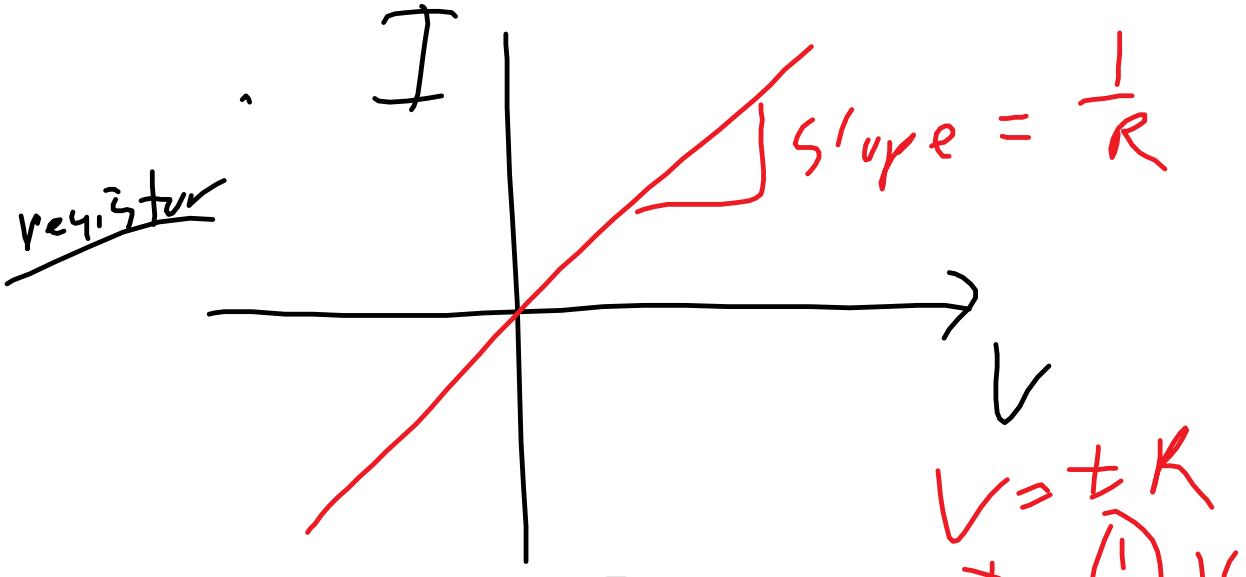
$loss = 7200\,pJ - 1800\,pJ$

$= \boxed{5400\,pJ}$

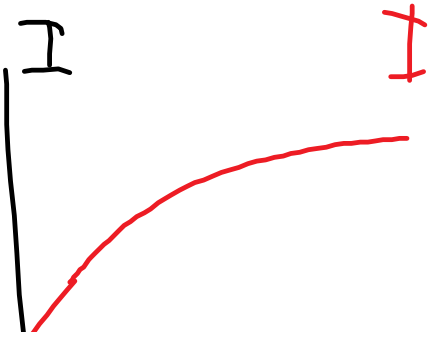
Diodes:

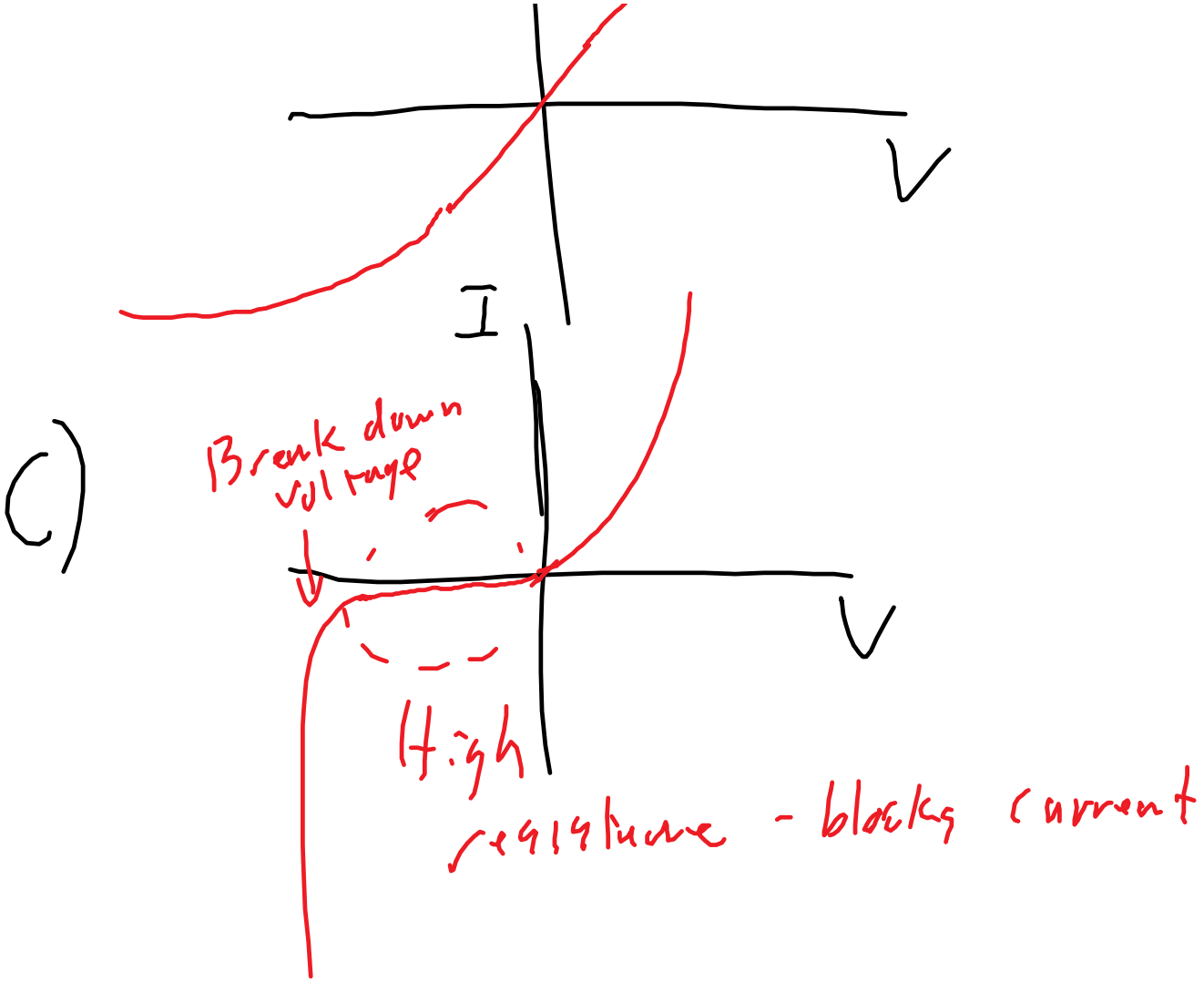
Doped and Rekt

Draw the I vs V graph for
a) An ohmic device (resistor)
b) A filament light bulb
c) A diode




b) filament






Why do diodes do that?
How can we use that?

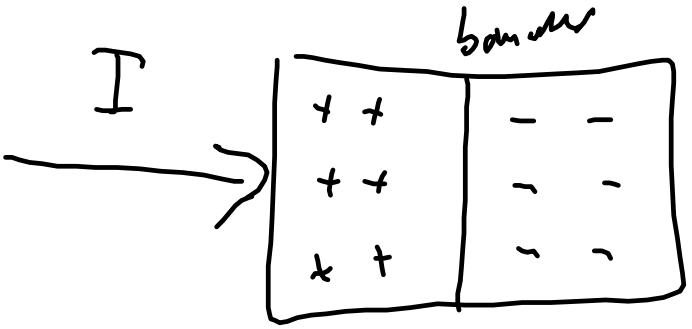
Diodes are made from semi-conductors with 2 parts with compounds embedded in the material - called doping.

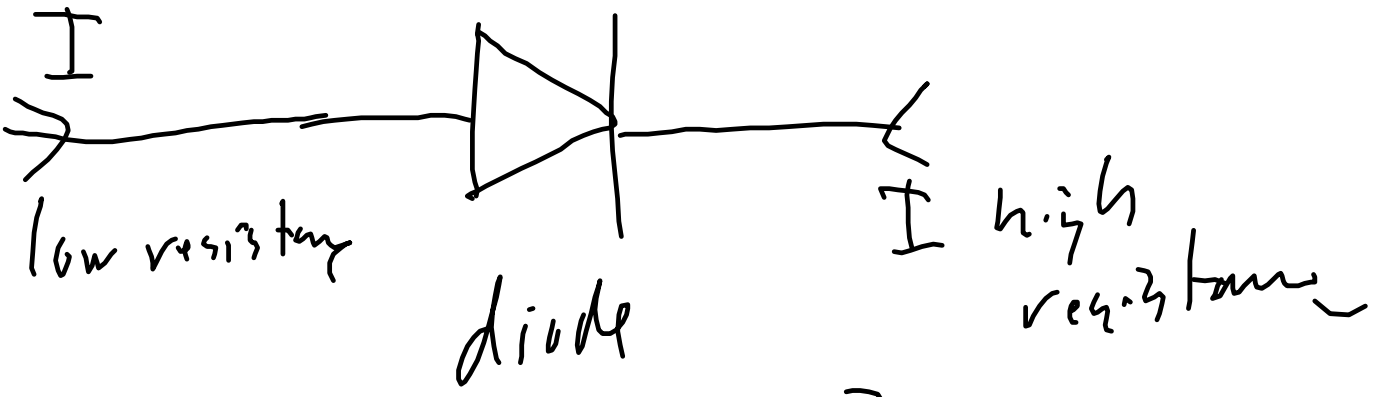
Silicon is a semi-conductor and if you add a material that has room for electrons in the outer orbital, it can create a "hole" that attracts electrons.  p-type

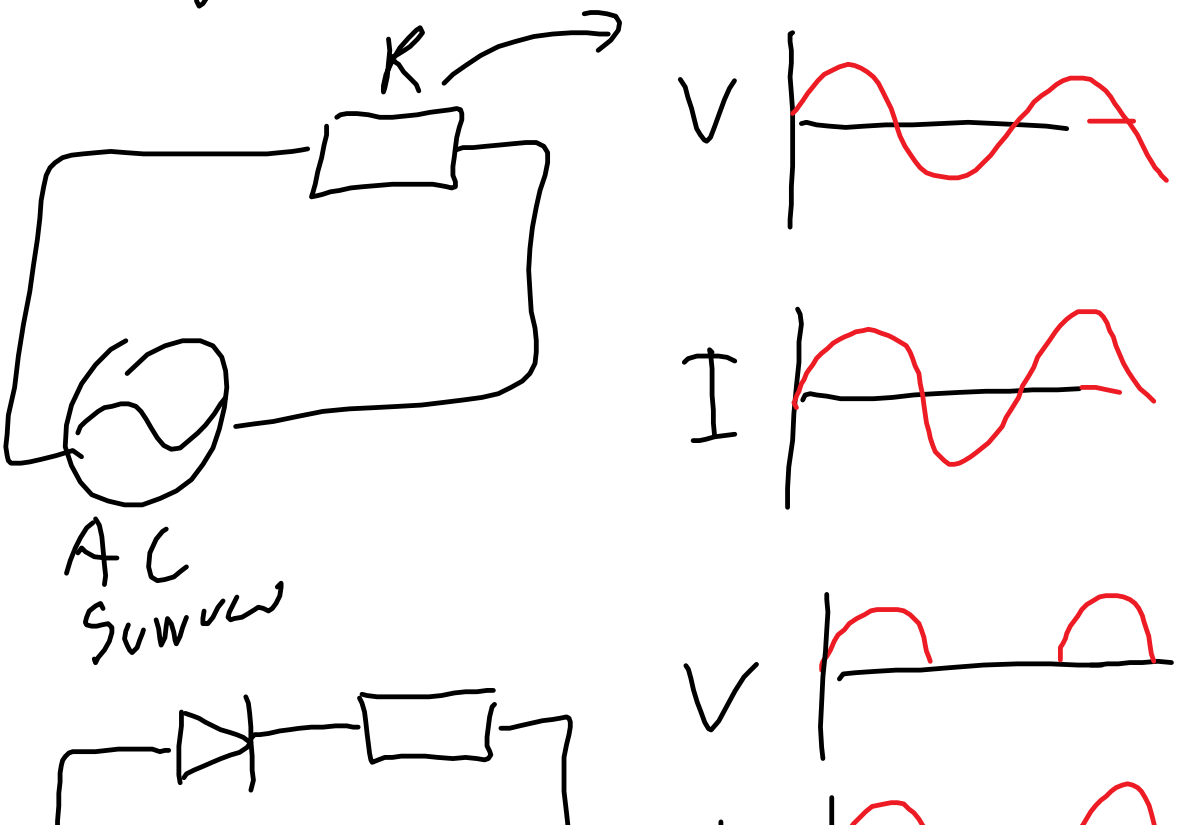
If a material has a free electron in the outer

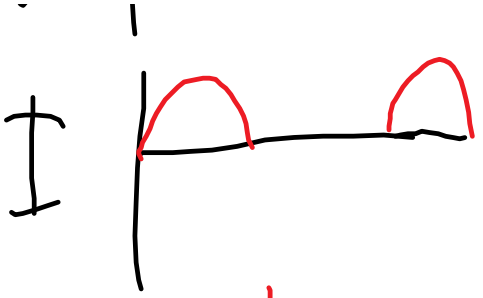
orbital, it can give off electrons easily. n-type

At the medium boundary between the two doped substances, there is a potential boundary that allows current to flow one way but not the other.

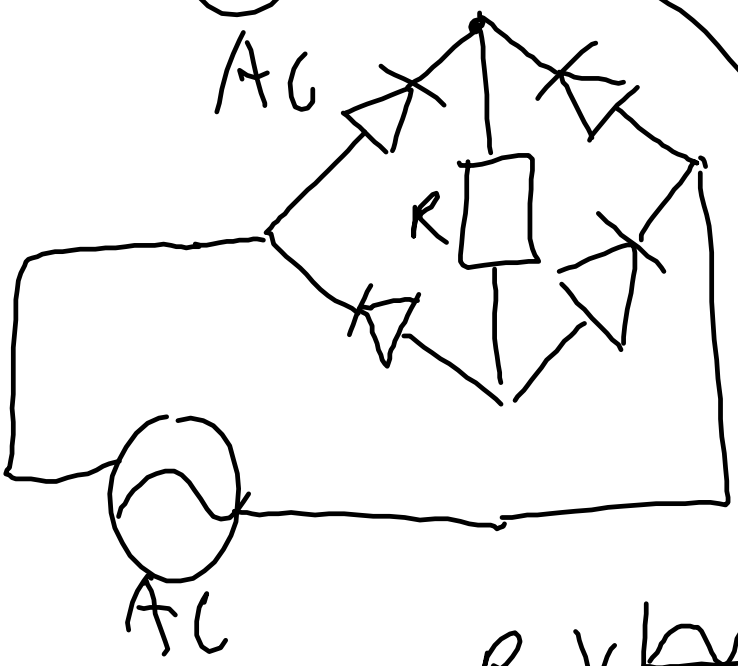


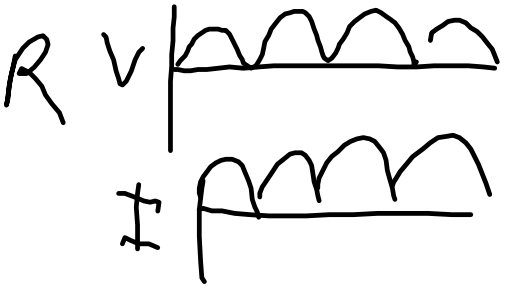






partial rectification




← full wave rectification




add a capacitor to smooth out the signal

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